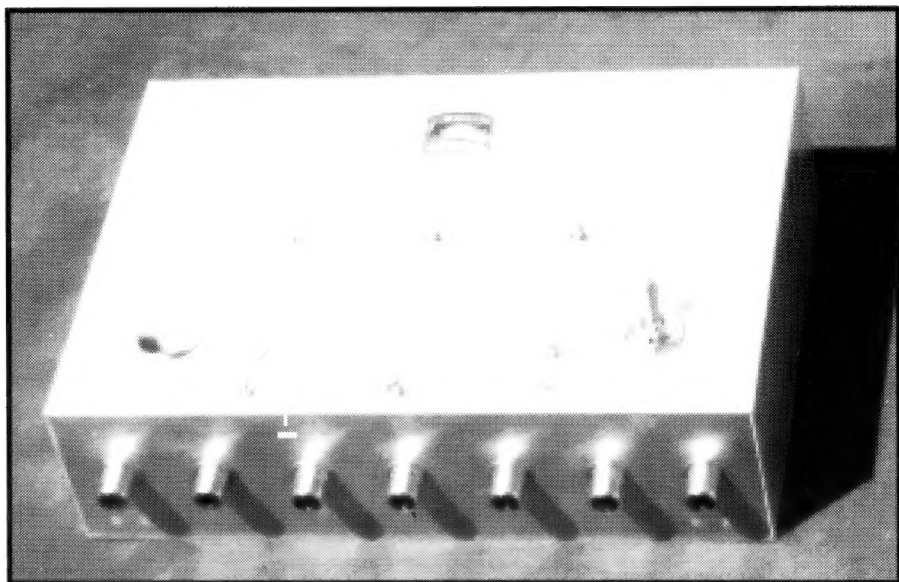


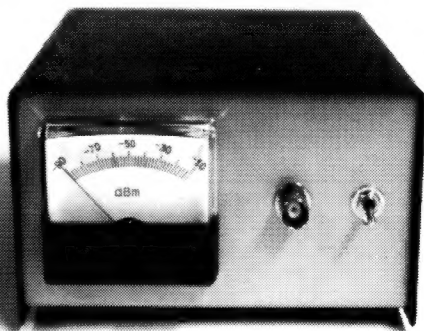
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FOR AMATEUR RADIO DESIGNERS AND BUILDERS



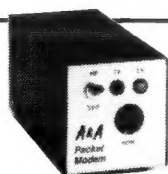
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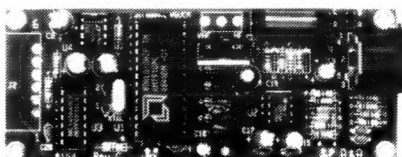


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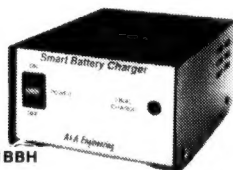
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FOR AMATEUR RADIO DESIGNERS AND BUILDERS

SUMMER, 1996 • VOL. 4, NO. 3

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• LETTERS •

From The Publisher

• QST •

Well, I have decided, after much hand-wringing and late-night meanderings about the house, to step down as publisher of *hambrew*.

This decision is not made lightly, and is drawn from the following facts:

1. *hambrew* has not built the 5000 subscription base as targeted when the magazine was conceived. Had every last subscriber renewed, we would have over 2200 subscribers at present. This alone would not sustain the magazine, but could cause some delay in favor of expanded readership. This has not been the case.

2. Competition from the many QRP publications, who have increased their project orientation, has diluted the market for a strictly builder-oriented publication. This conclusion is premature and could be argued.

3. Sluggish renewals, and lack of budget to really pursue and scatter reminders again and again to potential renewals.

4. Lack of time and manpower: the magazine is no longer a one-man operation. It could greatly benefit from a larger staff in its day to day operation. Yet it will not at present sustain a one-man operation.

5. Higher overhead of mailing and transportation. Prices for second-class and international first class are going up.

6. Increased vendor fees for VISA and MasterCard transactions.

Up to this point I have had to be a one-man publication as regards production, sales, editing, publishing, subscriptions, advertising, promotion, etc., etc. The magazine could benefit so much more from a staff of people who could segment these duties. It would be a

much better magazine for it.

Two Possible Solutions:

1. Sell the magazine at an affordable price to a ham or group of ham investors who are fundamentally sound in the area of technical expertise. This could be done as a "hand-off" with no up-front payment to buy the magazine out. This would insure that the magazine would not simply die with a whimper, but would have a quite good chance of surviving. The subscriber base has been established and there are a lot of us who still believe in the publication. With another two or more years of time to grow, and a fresh staff, the magazine stands a great chance of flourishing and generating real income.

2. Establish an international organization which would take over publication and all other facets of the magazine, as well as adding a larger dimension to the idea and prospect of what that organization might eventually become. More on this on the next page.

Whether one of the above solutions will prevail or the magazine glubs to the bottom of the sea of lost magazines, I will not publish *hambrew* beyond the Spring, '97 issue. My personal exigencies preclude the notion of my continuing beyond that point.

That there have been many others who have contributed their time and efforts to help along this magazine is most gratefully acknowledged. A glance at the tables of contents of past issues will reveal the recurrence of the names of many hams who have my undying gratitude. Thank you all.

hambrew does not have to fold. There are options that are very possible and do-able. For #2 above to succeed requires that each of the readers take stock of what they might contribute without financial remuneration (initially) to help make it a reality. I hope you will help.

Sincere 73, George, WFØK

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If you are ready to contribute directly to the production of *hambrew*, and wish to be considered for one of the above positions, indicate in a letter to us your preferences. If enough individuals respond, we will hand over the magazine and the organization, newly structured, to the readers and writers of this publication.

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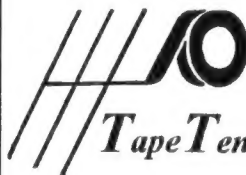
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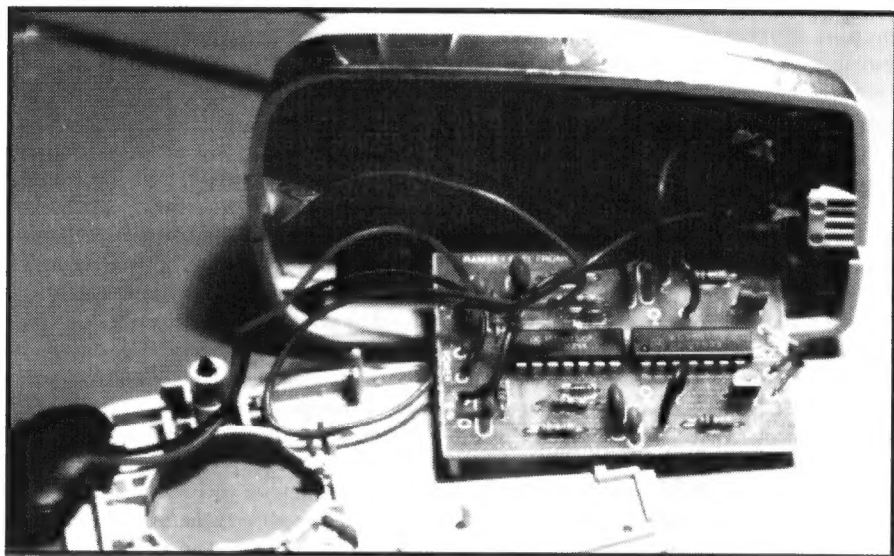
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KIT REVIEW

Almost But Not Quite

Marshall Emm, AAØXI / VK5FN

75230.1405@compuserve.com



*Ramsey Touch Switch installed in a mouse (additional photo on page 37).
(Photo above, and photo on page 37 by AAØXI / VK5FN)*

*Review: Ramsey Dual Circuit Electronic
Touch Switch CW Paddle.*

Cat. No. TS-1

\$6.95

Ramsey Electronics, Inc.

793 Canning Pkwy.

Victor, NY 14564

(800) 446-2295

Features:

Two independent switching circuits
Output can be momentary or latched
CMOS circuitry for low current drain
8-12V DC operation

In some countries it is customary to sacrifice a small animal before embarking on any ambitious endeavour. I sacrificed a mouse to the gods of kit-building, but I suspect the gods were busy with something else at the time.

The Ramsey "Ramsey Dual Circuit Electronic Touch Switch CW Paddle," looks like a good idea. And it's cheap. But cheap is in the eye of the beholder, and as sometimes happens the cost of the original kit is the least significant expense in a project. No matter how inexpensive, a kit is no bargain if it doesn't work or if it doesn't meet your expectations for performance.

A feature listed in Ramsey's catalog, and printed on the cover of the instruction booklet,

says "An economical alternative to expensive CW paddle devices." The catalog goes on to say "...kit includes info on using as a key for CW keyers." And of course it's very name includes the words "CW Paddle."

In point of fact the kit is most emphatically *not* a CW paddle or key. It is an additional electronic circuit which can be used between a touch paddle [which you must supply yourself] and a keyer. If I seem to be belaboring this point, it is because the description is misleading, and in terms of effort the kit is something less than half of what it says it is— or would be if it even worked as described.

Assembly:

There are only 21 components to mount, including 2 IC's (one of which is not needed in the "keyer" application). The board layout is symmetrical and quite simple, consisting of two independent switching circuits; in fact the entire kit is support circuitry for the two IC's. The first is a 4011 which, when triggered, momentarily turns on one of the final switching transistors (2N3904) depending on which input has been triggered. A 4013 is used to latch either output if toggle switch operation is desired, it can be left out entirely in the keyer application, but if you go through the construction sequentially you will not know that until you read the hookup and operation instructions after the board is complete.

Construction is really a no-brainer, so it is surprising that there are at least three errors in manual. U2 is shown as U5 on the parts overlay illustration; you are told to install "R1, 1K" when in fact R1 is a 10K resistor, and the *second* time they tell you to install R3 they really mean R4.

To use the unit as a touch keyer, you need to devise some sort of paddle. A drawing is provided in the manual, but I wasn't particularly keen on having a separate unit. So I sacrificed a mouse. The word "sacrifice" is used deliberately: almost everybody has a dysfunctional computer mouse or two lying around, but in the course of preparing mine for its new life as a paddle, it turned out that the

only fault was a broken wire in the cable, so I could have fixed it easily enough.

I calculated that if I gutted the mouse, there would be room inside for the touch circuit and a 9v battery, and of course the mouse already has two "switches." To make the mouse switches touch-sensitive, I simply applied two strips of NFØZ's TapeTenna™ conductive copper tape. For more info about TapeTenna and its gazillion uses in the shack, call Larry at (303) 795-9466.

Operation:

The theory of operation runs a bit contrary to expectations. One would think that a touch switch would operate on either capacitance or conductance. Either the added capacitance from your body is detected, or there are separate contacts on the touch plate which are bridged by your slightly conductive skin. But no, this circuit appears to be voltage driven. It expects a current to be conducted from your fingertip into the circuit.

Where does this voltage come from? According to the manual, "Reliable touch switch operation depends on your body passing on to the touch inputs some of the AC 50Hz energy that's usually all around us, or a bit of static electricity, or both."

Note the word "reliable," because the manual admits that in some cases the switch just might not work.

What I found was that if I had been moving around the shack, I stored up enough static to trigger the device once. Somehow I wasn't convinced that it would be practical to run around the shack, send a dit, run around some more and send a dah....

First suggested remedy from the booklet: the inputs are bypassed, which makes sense in an RF environment, but you can remove the bypass caps if necessary. I have spent many an hour troubleshooting RF related problems, so this didn't look like a good idea. In fairness, it should be said that this approach might be appropriate and successful if you are using the device in some other application than a paddle.

(Continued on Inside Back Cover)

A Tuneable Lo-Pass Filter

Raymond Megirian, K4DHC

606 SE 6th Avenue, Deerfield Beach, FL 33441

Among the useful ICs of recent years are the variety of switched-capacitor filter available for tailoring the audio frequency response of circuits we use every day.

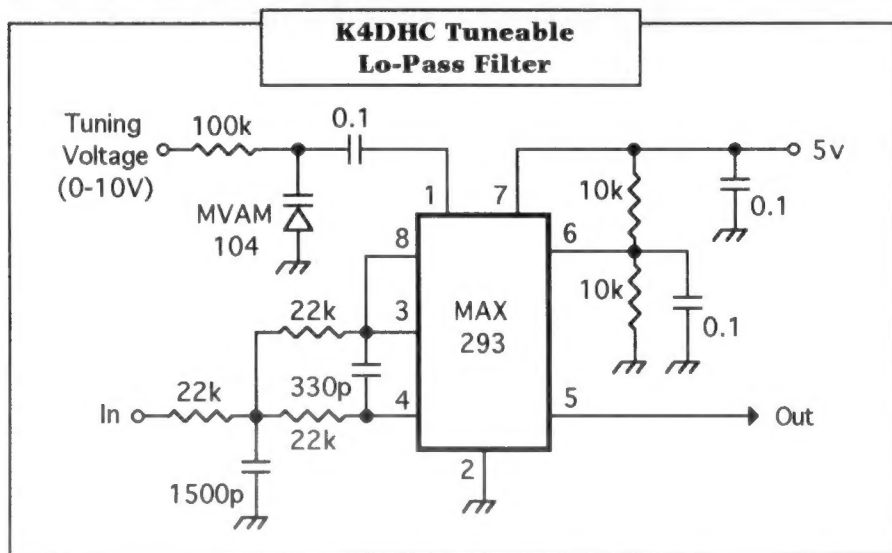
One such item that sparked my interest was the MAX 293 low-pass filter by Maxim Integrated Products, Inc. Here was an 8th order elliptic filter in a 8-pin DIP package that included an on-board oscillator that would generate an internal clock frequency with only the addition of a single capacitor. This latter feature got me to thinking how simple it would be to substitute a varactor diode for the fixed capacitor and end up with a filter whose cut-off frequency could be made continuously variable.

The schematic shows the end result of my efforts, and yields a filter which is tuneable down to approximately 450-500Hz. The upper cut-off frequency can be set by limiting the voltage applied to the varactor diode at some

specific value. The diode I used has a limit of around 10V and at this level the filter cuts off beyond 10kHz. Normally I would set the maximum voltage for a passband of around 3kHz. In case you are wondering, I did put 2 diodes in parallel, which produced a response that divided the previous results by two. The filter now tuned from about 230Hz to somewhat over 6kHz.

The IC also included an uncommitted op amp which in this case was used as a 10kHz low-pass filter at the input. As shown, the circuit operates from a single 5V supply, although the device can be used with dual supplies.

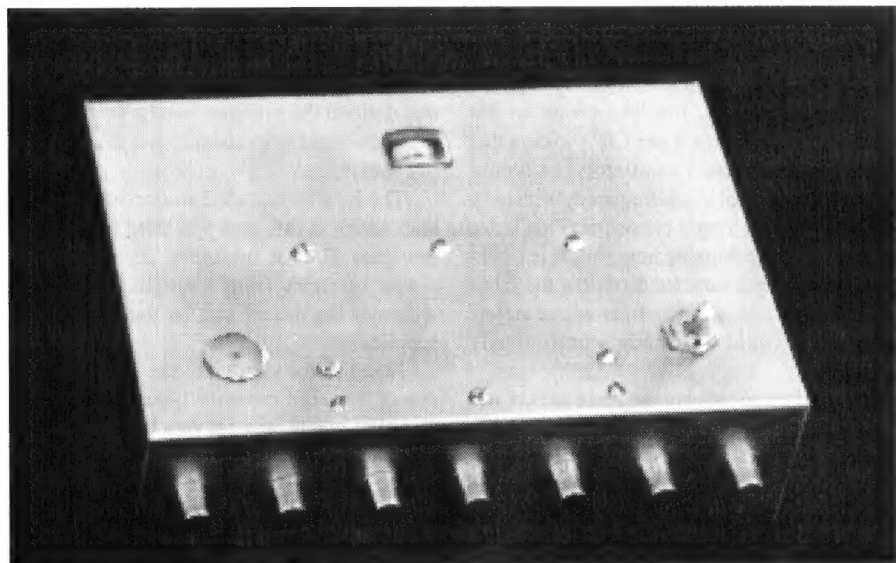
Note that the varactor diode will have to be one of the high capacity types. These have shown up at low prices at various suppliers and present no problem. The Maxim line of ICs is available from Digi-Key.



A Simple 50 Watt RF Amplifier

Lew Smith, N7KSB

**4176 North Soldier Trail
Tucson, AZ 85749**



This 50 watt RF amplifier is easy to build and uses readily available low cost parts. It can be built for any single band from 80 through 15 meters or it can be made to work on multiple bands with external networks.

The circuit of figure 1 uses a 90-cent power MOSFET in a simple single-ended configuration. C1, C2, C3, L1, and L2 compose a five element harmonic filter. C4 and L3 form an impedance transformation network to raise the 20 Ohm MOSFET impedance up to 50 Ohms at the antenna terminal.

The unconventional placement of the harmonic filter (usually the impedance transformation network is adjacent to the MOSFET and the filter is adjacent to the antenna— not vice versa) was done so that a 20

Ohm filter could be used. This lower than normal filter design impedance makes it practical to use air wound coils.

Air wound coils do away with the loss, and also the cost, of powdered iron cores. Usually, bare wire can be used, thus eliminating the job of scraping enamel from the ends of the coil. Furthermore, air wound coils can be stretched or squeezed to get an exact value of inductance. However air wound coils are not self-shielding. This means that coils should be spaced one (and preferably two) coil diameters from each other. Adjacent coils should be mounted at right angles to further insure that unwanted coupling does not occur.

The input circuit uses four paralleled 2 watt metal oxide resistors to insure stability. A

ferrite core transformer is used to match the input to 50 Ohms.

A 48 volt supply is needed for full output. The very simple unregulated but well-filtered supply shown in figure 2 works well. Three 12.6 volt, 3 amp Radio Shack transformers were used because they were much easier to obtain than a single 38 volt unit. The unloaded power supply output is 57 volts, a string of dots will bring it down to 49 volts, and the voltage will drop to 46 when the key is held down.

Class B or Class C

On 20 meters the basic class C amplifier shown in figure 1, requires 5 watts of drive for a full 50 watt output (6 watts is needed on 15 meters and 4 watts is needed on 40 or 80). Output falls off rapidly if the drive is reduced. For example, with 2.5 watts of drive the output falls to 13 watts.

Class B operation is possible with the addition of the extra components shown in figure 3. This mode requires less drive and also offers linear operation for SSB. In the class B mode the power gain is a constant 25 from zero to 40 watts out. Although the amplifier becomes nonlinear above 40 watts out a 50 watt CW output can be produced if the input is increased to 4 watts.

Regardless of which circuit is used, the

drive should be kept under 10 watts. The MOSFET is likely to be destroyed if the drive exceeds 15 watts.

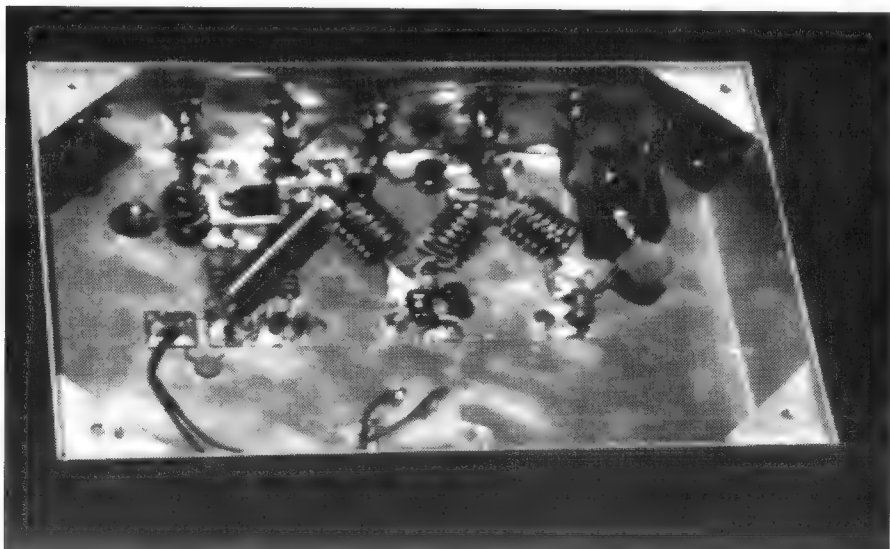
Single Band Operation

Component values are given in table I for any single band from 80 through 15 meters. Allowance has been made for stray capacitance and the output capacitance of the MOSFET. The coil winding data assumes a 1/4" lead length on each end of the inductor.

Multiband Option

Multiband operation is possible if one uses the 20 Ohm, 22 MHz cut-off Chebyshev filter of figure 4 plus separate external networks for each band. On 20, 17, and 15 meters each external network consists of nothing more than two short pieces of coax. The coax network transforms the 20 Ohm output impedance of the Chebyshev filter to 50 Ohms and also attenuates the second harmonic by an extra 30 db.

The coax networks are too bulky to use on 80, 40, and 30 meters. Furthermore, neither the coax network nor the 22 MHz Chebyshev filter will attenuate the third harmonic of a 40 or 80 meter fundamental. For these reasons, LC circuitry was used for the 30, 40, and 80 meter external networks. The length of the coax connecting the amplifier to the 30, 40, or



80 meter external networks should be 2 feet or less.

Construction

A 5 x 7 x 2 inch LMB # 572 chassis was used. The MOSFET was heat sunk to the chassis using a Radio Shack TO-220 mounting hardware package containing a mica insulator, nylon washer, nut, and bolt. A small dab of heat sink grease should be applied to both sides of the mica insulator to improve thermal conductivity. At the 50 watt level the chassis is an adequate heat sink and the usual massive extruded aluminum fins can be omitted.

Instead of an etched board, solder lands were made by cutting up 1/2 by 1/2 inch pieces of printed circuit board material. I used a product sold as GOOP to glue these 1/2 by 1/2 inch solder lands to the chassis. Two 3/8 inch wide brass strips were bolted to the chassis to allow easy solder connections to ground.

The coils are easy to make. Bare # 14 wire can be pulled out of the house wiring cable sold in hardware stores. Note that the 80 meter coils must use enameled wire to prevent the close spaced turns from shorting. The wire should be stretched to remove any kinks. A 3/8 inch rod or the shank of a 3/8 inch drill bit can be used as the winding mandrel. The RF choke was made by winding 40 turns of # 22 enameled wire on a 3/8 inch plastic rod. The coils were

mounted in zig-zag fashion to minimize unwanted coil-to-coil coupling.

The meter is a low cost surplus edgeview unit. A shunt resistor was used to turn the 200 microamp meter into a zero to 2 amp indicator. I used a 1/2 inch long single strand of a multi-strand 1/8 inch stainless steel cable for the shunt. A bit of experimentation was required to find the right length for the shunt. Although silver alloy solders are usually used to solder stainless steel, I found regular 60/40 solder to be acceptable.

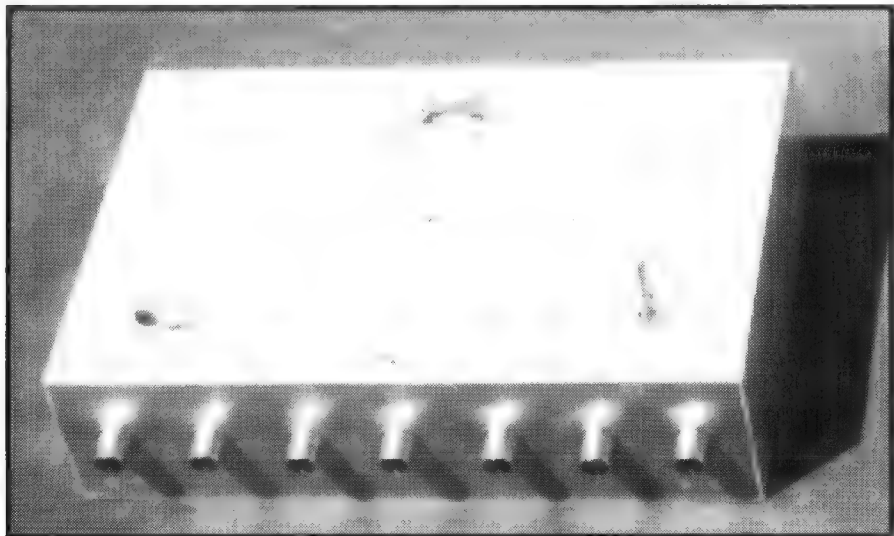
Heavy RF currents will destroy some types of capacitors. Do not use monolithic capacitors anywhere other than for C5 and C6. Mica capacitors rated at 500 volts or more should be used for C1, C2, C3, and C4. Disk type ceramic capacitors should be used elsewhere. C7, C8, C9, and C10 should be rated at 500 volts or more.

Be sure to use metal oxide resistors for R1, R2, R3, and R4. Wire-wound resistors are too inductive for RF use.

Although a metal chassis could have been used for the power supply, I used a 10 inch piece of a 1 x 6 inch wood plank. Brass wood screws were used to fasten the parts. Brass escutcheon nails were used as solder lugs.

Testing

Before applying power, use an ohmmeter



N7KSB 50 WATT CLASS C AMPLIFIER

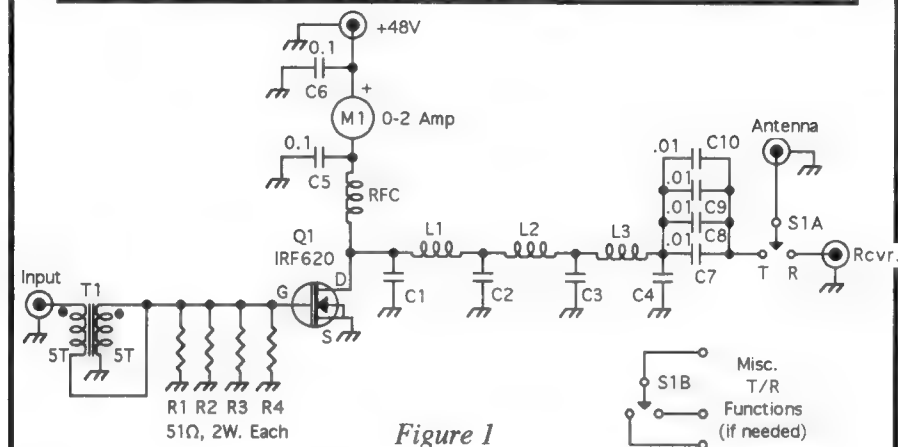


Figure 1

Parts List

C1, 2, 3, 4	See Table I, Mica
C5, 6	0.1 μ F, 100 Volt Ceramic
C7, 8, 9, 10	0.01 μ F, 500 Volt Disk Ceramic
L1, 2, 3	See Table I
M1	0-2 Amp Meter (See text)
Q1	IRF620 Power MOSFET
R1, 2, 3, 4	51 Ω , 2 Watt, Metal Oxide
RFC	40 Turns #22 Enameled wire, closewound on 3/8 inch plastic rod
S1A, B	DPDT Switch
T1	5 Turns Bifilar, #22 Enameled wire on FT50-43 Core

to check out the T/R switch and to insure that the amplifier does not present a dead short to the power supply. If the class B circuit is being tested, use the ohmmeter to set the arm of the trimpot to ground.

Next connect a dummy load to the output and apply power. If the class B circuit is being used, reset the

potentiometer so that the amplifier draws approximately 30 milliamps with no drive power applied. Next tap the key. The supply current should jump to roughly 1.5 amps and

the output should be about 50 watts.

On 20 meters this amplifier presents a 2.5:1 SWR to the driver. The input SWR increases to 4:1 on 15 meters. This SWR may cause the driver to put out reduced power. If the input SWR is a problem, it can be reduced by connecting a 45 inch long shorted coax stub to the input port. The coax stub should be removed when operating on 30, 40, or 80 meters.

Final Comments

Low cost MOSFETS are a good choice for

a final amplifier. Recently jumbo sized TO-247 packaged versions have become available. These new types have power ratings of up to

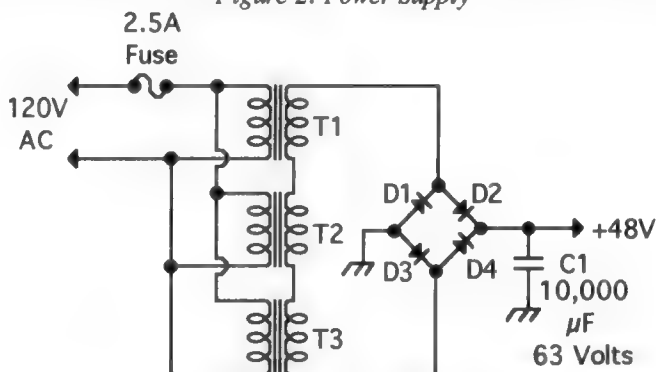
300 watts. It won't be long before half KW amplifiers are built with these useful devices.

Table I: Single-Band Component Values

L1, L2 and L3 are self-supporting air-wound coils, 3/8 inch inside diameter. Enameled #14 wire must be used for the 80 meter coil. Either bare or enameled #14 wire can be used for the other bands.

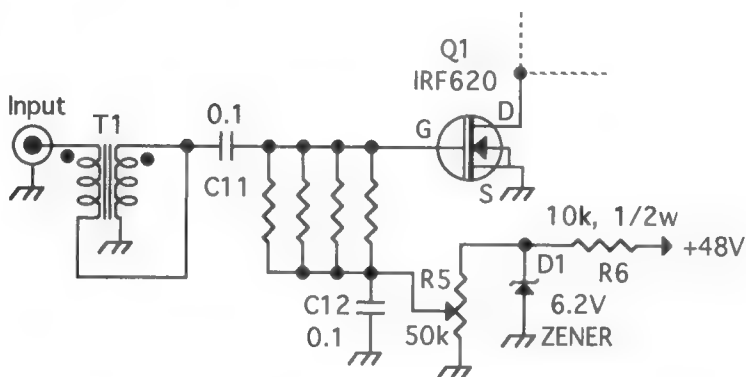
	15 M	17 M	20 M	30 M	40 M	80 M
L1, L2	5 turns, 16mm long	6 turns, 21mm long	6 turns, 15mm long	7 turns, 14mm long	10 turns, 23mm long	14 turns, 23mm long
L3	6 turns, 19 mm long	6 turns, 14 mm long	7 turns, 17 mm long	8 turns, 16 mm long	12 turns, 27 mm long	17 turns, 23 mm long
C1	150pF	220pF	330pF	560pF	910pF	2000pF
C2	750pF	860pF	1100pF	1600pF	2200pF	4400pF
C3	360pF	430pF	560pF	780pF	1100pF	2200pF
C4	180pF	200pF	270pF	390pF	560pF	1100pF

Figure 2: Power Supply



- C1 10,000 μ F, 63 Volt Electrolytic Capacitor
 D1, 2, 3, 4 4 Amp, 400 Volt Bridge Rectifier
 Fuse 2.5 Amp
 T1, 2, 3 Radio Shack 12.6 Volt, 3 Amp Transformer

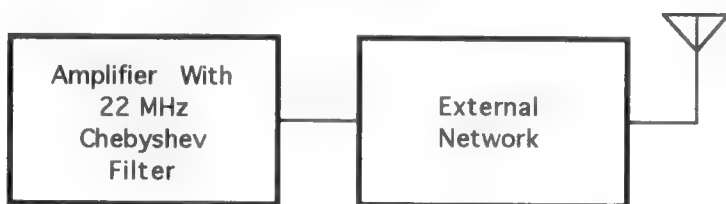
Figure 3: Modification for Class B Operation



Added Parts:

C11, C12	0.1 μ F, 100 volt disk ceramic
D1	1N4735, 6.2 Volt Zener Diode
R5	50k Trimpot
R6	10k, 1/2 watt resistor

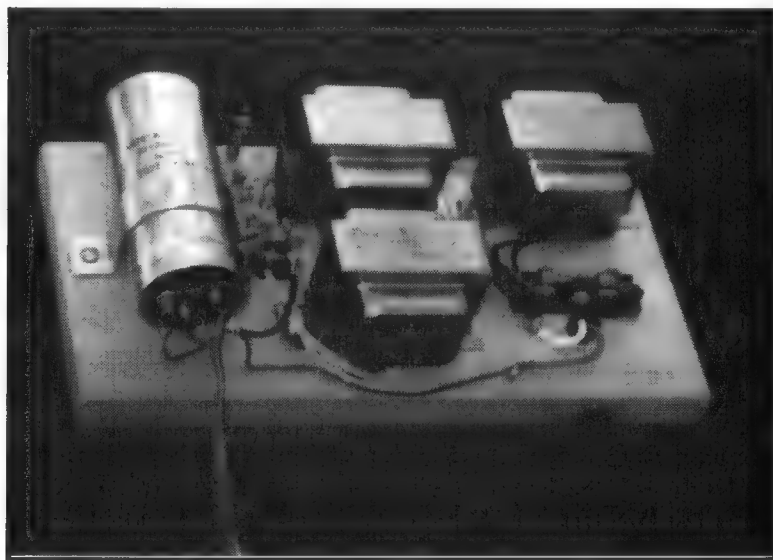
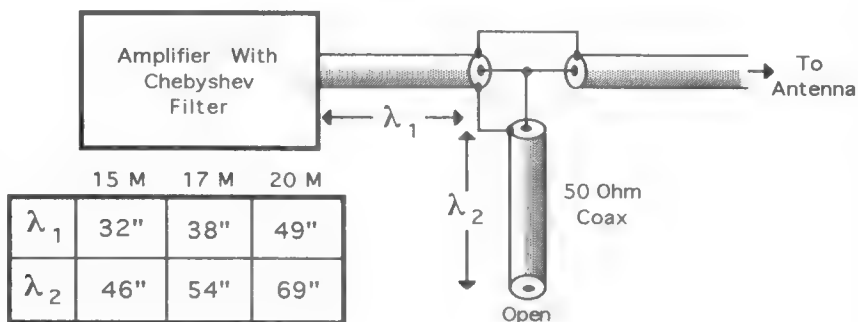
Figure 4A: Multi-Band Configuration



Changes Required For Chebyshev Filter

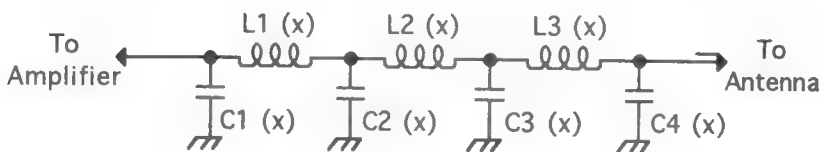
C1	200 pF Mica
C2	780 pF Mica
C3	780 pF Mica
C4	420 pF Mica
L1	6 Turns, 15mm Long
L2	6 Turns, 17mm Long
L3	6 Turns, 15mm Long

Figure 4B: Coax Networks For 15, 17 and 20 Meters

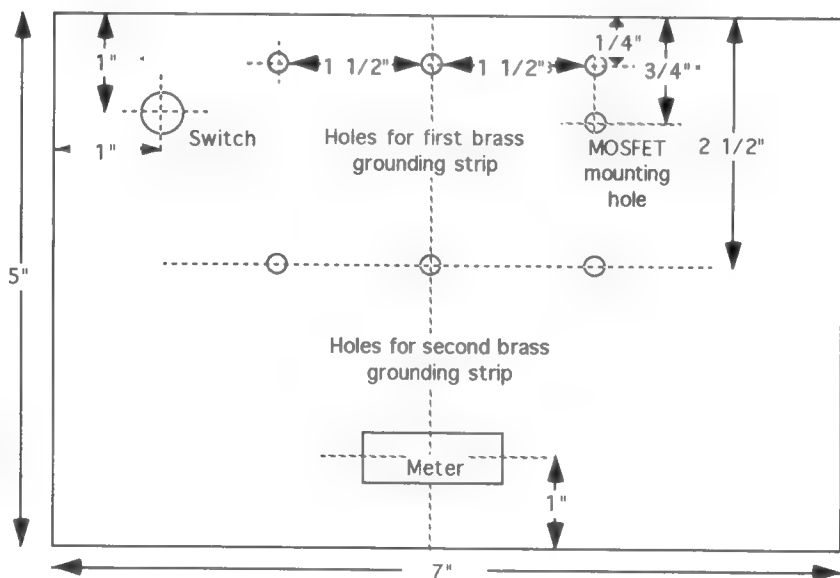


Breadboarded version of the 48 Volt power Supply.

Figure 4C: External Networks For 30, 40 or 80 Meters



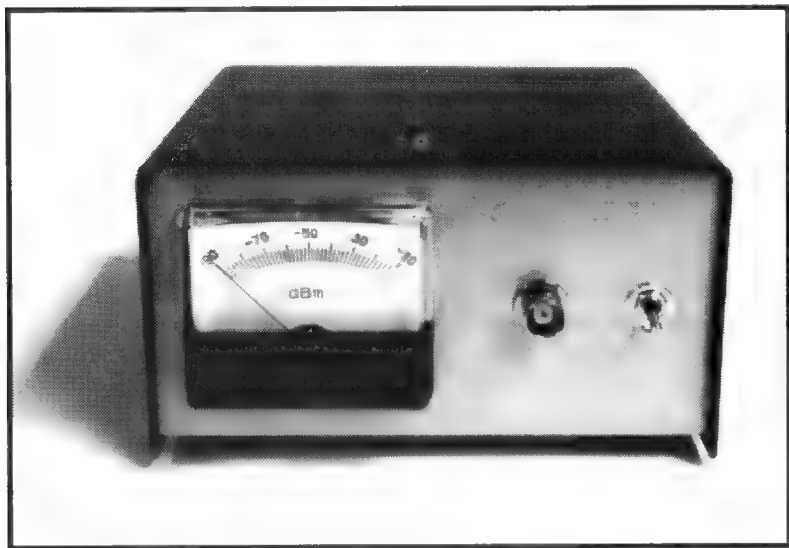
Except for C1 (x), use the values given in Table I for L1, L2 Etc. For C1 (x), use the Table I value given for C3.



Top View of Chassis Showing Hole Locations
(Not to scale)

Reviewing the dBm Meter

John Pivnichny, N2DCH



Radio experimenters need a way to measure relatively weak RF signal levels in their receiver circuits and filters. A dBm meter is a handy item to have and especially if it covers a 60 to 80 dB range (over 1000:1 ratio of signal levels). This article reviews the circuit published in *Electronics Now* magazine of September 1995 pages 112-113 and 158-159.

Figure 1 shows the schematic for the relatively simple meter with an 80dB range. It's based on using the RSSI (tuning meter) output of the well known and low cost RCA FM IF integrated circuit CA3089. The frequency range is 2 to 20 MHz. However the meter can be used for comparison purposes for frequencies up to 50 MHz.

One problem with the RCA part is that its RSSI output is not linear for strong signals, see figure 2. A diode and resistor combination is

used to shunt some dc current around the 100uA meter movement at the high end to "straighten out" the curve.

Building the Meter

You can build the meter from scratch or else purchase a complete kit shown in photos A and B from Unicorn Electronics.¹ Most of the parts are soldered into a 1 1/2" x 2" circuit board. This board is then mounted in the case along with the meter movement, switch, BNC connector, and battery holder. Final connections are made and that's it. The whole assembly can be completed in one evening. The kit included every screw, nut etc. needed except for some solder and 8-AA batteries.

Calibration

You calibrate the meter by feeding an RF signal into the BNC connector and adjusting its level for a dc voltage on pin 1 of IC1 of 2 volts. Then adjust the calibration pot P1 for a reading of -50 dBm on the meter face (in the center of the meter scale).

I used a home-brew signal generator ² with an adjustable level control for this procedure. I set it at 10 MHz and connected it directly to the BNC jack on the front of the meter. If your signal source doesn't have a level control, you can use an attenuator box or just a 1k ohm pot in series with the signal lead to set the level.

Another way to make this adjustment would be to wind a two turn coil one inch in diameter using hook up wire and connect it to the BNC jack on the meter. Then use a dipper set to 10 MHz and couple the dipper to this two turn link by inserting the dipper coil inside the link coil. Adjust the positioning of the two coils for a dc voltage of 2 volts on pin 13. Then set P1 for -50 dBm on the meter face.

The dB scale

I've found it's helpful to keep the following ratios in mind when using dB readings:

a voltage ratio of 2 to 1 = +6 dB
 a voltage ratio of 10 to 1 = +20 dB
 a voltage ratio of 1/2 to 1 = -6 dB
 a voltage ratio of 1/10 to 1 = -20 dB
 a power ratio of 10 to 1 = +10 dB
 a power ratio of 1/2 to 1 = -3 dB
 a power ratio of 1/10 to 1 = -10 dB

Also when measuring RF signals you will have a sine wave, unless there are harmonics present or multiple signals. With a sine wave the following applies:

rms voltage = $.707 \times$ peak voltage = -3 dB difference
 rms power = $.5 \times$ peak power = -3 dB difference

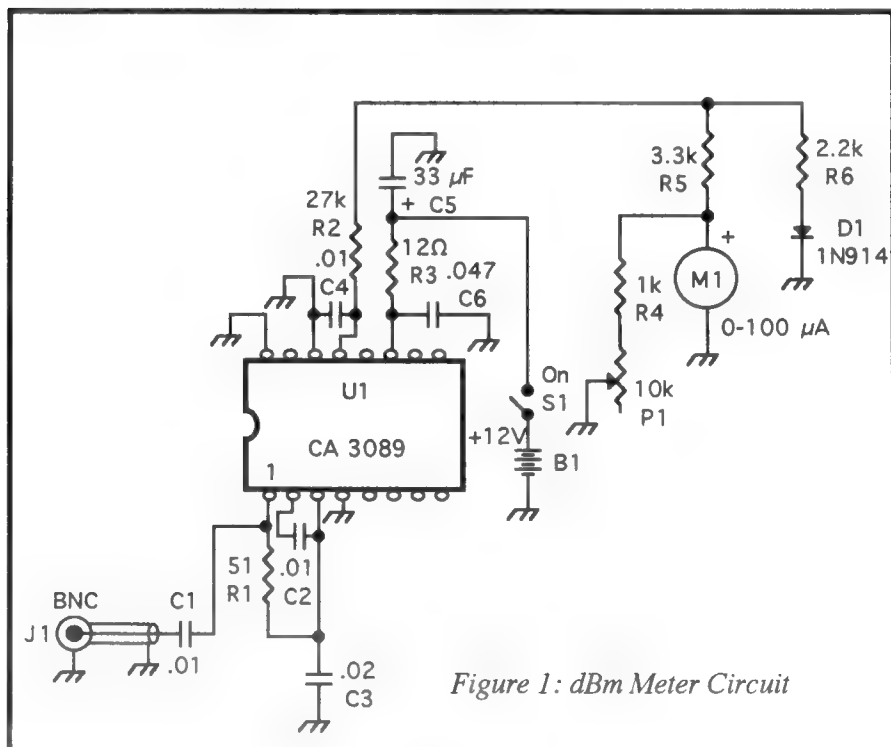
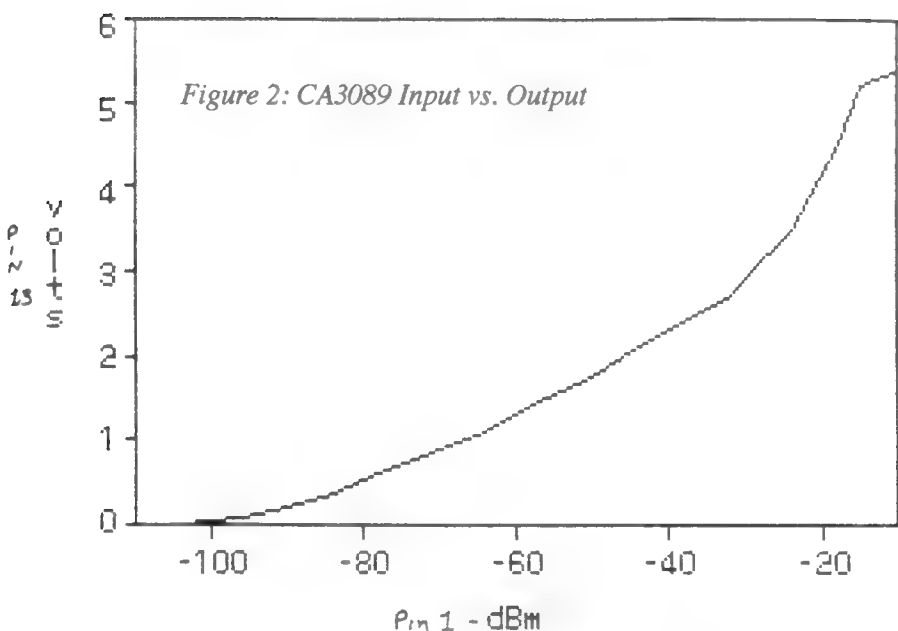


Figure 1: dBm Meter Circuit



So what's a dBm? By definition zero dBm is an rms power of one milliwatt (usually dissipated in a 50 ohm load)

0 dBm = 224 mV rms across a 50 ohm resistor
 0 dBm = 316 mV peak across a 50 ohm resistor

So, for example, a signal of -30 dBm is 1/1000 of a milliwatt or just one microwatt. This signal will have a rms voltage of 7 millivolts across 50 ohms.

Measuring a Filter

I've found the dBm Meter to be very useful for checking out bandpass and low pass filters. By plotting the attenuation vs frequency curve I can make sure that a filter I've built has the correct characteristics. See figure 3 for a typical set up.

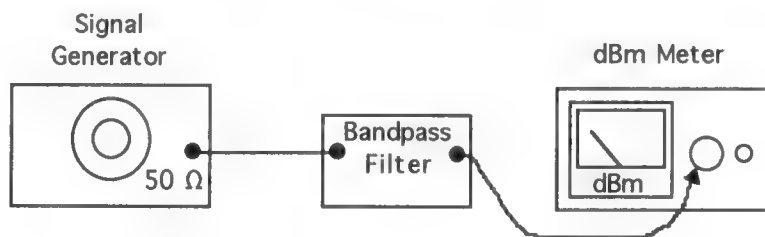
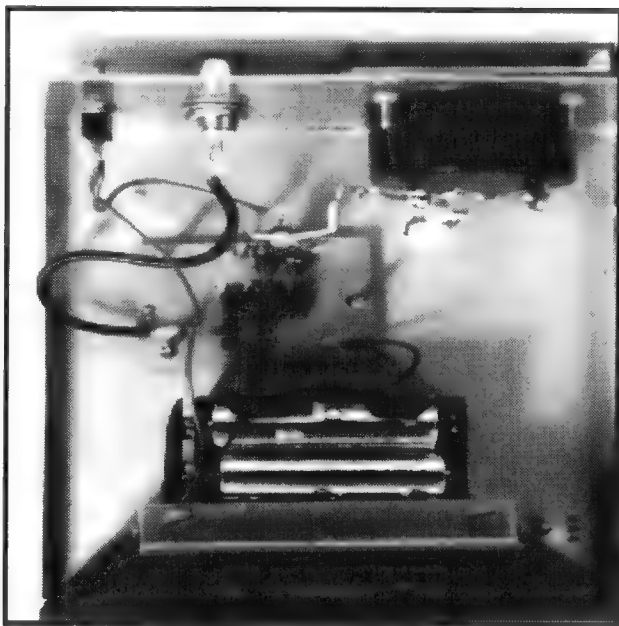


Figure 3: Typical Test Setup



Crystal Filters

Is that crystal filter in your QRP radio performing? How wide is it? Is 4 poles enough? I use my dBm Meter to measure the passband of my crystal filters. But note that a very stable signal generator with vernier dial is needed. Also, most crystal filters have higher than 50 ohms termination impedance. Let's say you have a 4 pole filter (4 crystals) with 200 ohm impedance. Use the set up in figure 4.

The matching resistors will each introduce 12 dB loss. But this will not change the shape of the attenuation curve of the filter because all frequencies are reduced by 24 dB.

Checking for RF signals

Is that VFO working? Suppose you try to check the output frequency of a VFO circuit with your frequency counter and get no reading. Is the signal too weak for the counter or is there no signal at all? This dBm Meter can read signals much weaker than most counters. Of course the dBm Meter won't tell you the frequency.

Field Strength Meter

A dBm Meter makes an excellent and very sensitive field strength meter. A simple whip antenna will suffice for many readings. You can measure antenna patterns and adjust matching networks to maximize radiated power. This particular meter is about 1000 times more sensitive than the simple diode meters described in radio handbooks. Because it's battery powered, you can take it out where the antenna is located.

Conclusion

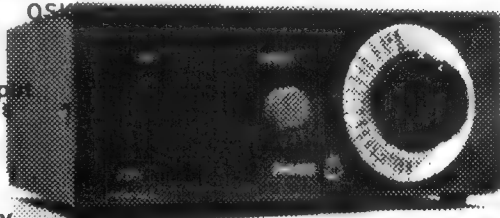
Overall I've found the dBm Meter to be a very useful instrument to have around the shack. A simple one like Figure one can be built up at a low cost. So if you're going to be experimenting with RF signals, then I'd recommend adding one to your equipment.

References

[1] A complete kit of all parts including circuit board, drilled case, and meter with dBm scale

Announcing The MXM Simple Transceiver

- Double-Conversion Superhet
- Electronic Instantaneous OSK
- Transmit Monitoring
- Superb Sensitivity
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- Variable Pitch
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MXM Industries announces their new concept in QRP high-frequency equipment for the home builder, the Simple Transceiver! This revolutionary new design permits the experienced homebrew constructor to have the finest QRP station in existence today. Based on the MXM line of Simple receivers and transmitters, the selectivity and sensitivity of this design are unmatched by any other equipment at any price! The complete station is on a board that is only 3-1/2 inches by 4-1/2 inches in size—just right for that portable or backpack rig you've always wanted! The tuning capacitor, bandwidth capacitor and cabinet are included in the kit. The cabinet is 0.040-inch aluminum, 6-1/2 inches wide by 5-1/2 inches deep by 2-1/2 inches tall.

All you need is a volume control, coax connector, and jacks for power, keying, and audio output, and you're on the air!

The Simple Transceiver is covered by the MXM warranty—If you can't make it work, send it back and WE WILL!

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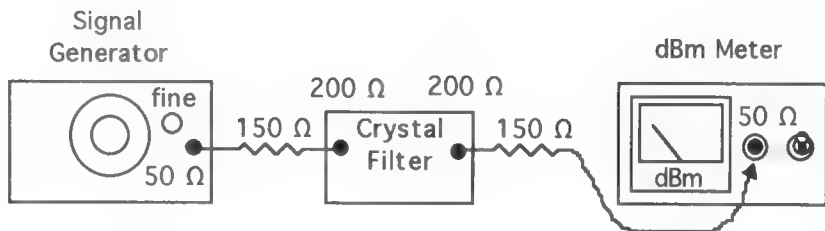
Address _____

City _____ State _____ Zip _____

☐ VISA ☐ MC#

Exp: _____

Foreign Rates: \$21/year; Canada, Mexico \$15/year



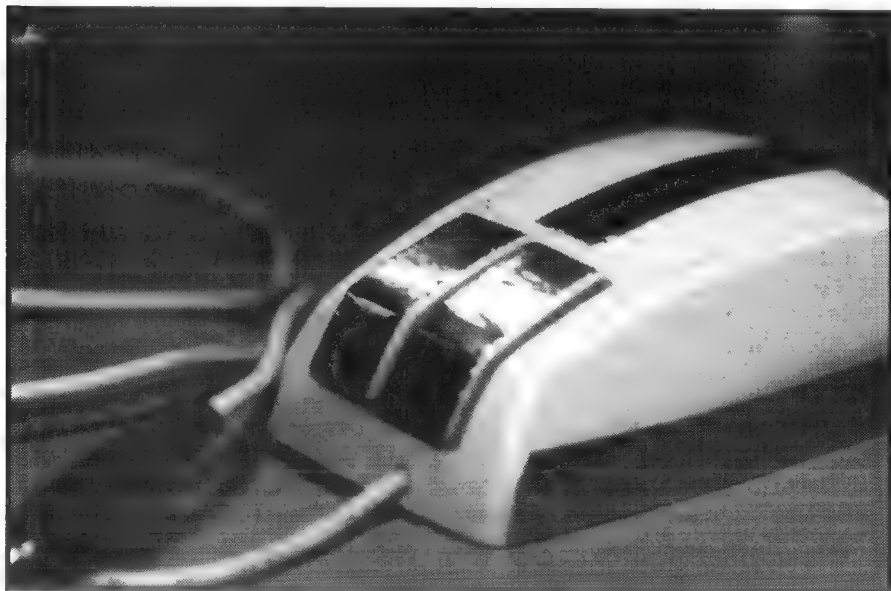
*Figure 4: Matching Crystal Filter
With 150 Ohm Resistors*

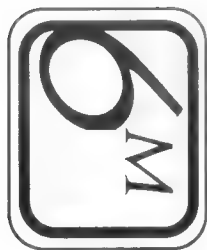
is available for \$49.95 from Unicorn Electronics, Inc. Valley Plaza Drive, Johnson City, NY 13790 (607) 798-0260. They also have a 0-100uA Meter movement with dBm scale for \$18.75 and a circuit board for \$3.00. Add

\$3.50 shipping and handling. New York State residents add local sales tax.

[2] "Calibrated Signal Generator," 73 Magazine, July 1992 pp 26-30.

(Continued from page 8)





Deep Six

Fred Bonavita, W5QJM

PO Box 2764
San Antonio, Texas 78299

Eye on 50 MHz

It may be nice — or even advantageous — but it's not necessary to live under an aluminum overcast of beams to enjoy 6 meters.

Stacked killer arrays may be the order of the day in some places, but they are the exception rather than the rule. After all, how many of us need or even want 14 elements on a 61-foot boom at 60 feet so we can work 6 meters? And how many of us would have a spare Chevrolet engine to turn it once we got it up there?

Fortunately, 6 meters is a lot more casual than that. It's possible to get some solid enjoyment from a pure-vanilla beam or quad of 2, 3 or 4 elements at just above roof level and turned with a simple tv-type rotator. If a small beam is out of the question, try a vertical or reliable j-pole.

It's not necessary to limit yourself to beams from the Cush-KL-Gain crowd, either. Several small companies are making 6-meter beams and quads with reasonable dimensions and price tags, and they give the 6-meter enthusiast a variety of sources from which to choose.

In no special order and with the warning that none of these has been tested by me, 6-meter antennas are offered by:

NEW WAVE ANTENNAS: If you have a QST for January 1995, look at the cover photo of the rover vehicle belonging to Randy Simons, NØLRJ, owner of this company. Look carefully

at the 6-meter beam on the top of that stack, and note that the elements are folded back on themselves — an unusual and space-saving move. Randy has 3-, 4-, 5- and 6-element beams available. Write for his catalogue at 3320 South Knox Court, Englewood, Colo. 80110. The phone is 303-761-1458.

KWAD-KITZ: This company offers a 2- or 3-element yagi designed with portability in mind. Loosen two screws, and it breaks down in easy-to-pack sections. Catalogue: Box 16643, Sheboygan, Wis. 53082-1643. Toll-free number: 888-531-3100.

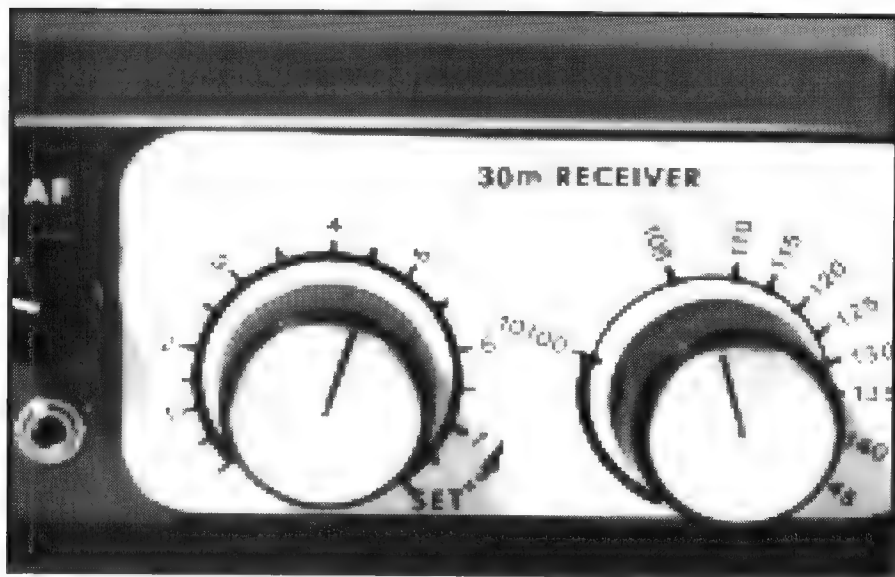
RUTLAND ARRAYS: Rutland has been around for a while, and has earned a good reputation among 6-meter enthusiasts. It has 4-, 5- and 7-element beams. Catalogue from 1703 Warren Street, New Cumberland, Pa. 17070. 717-774-3570.

FAIR RADIO SALES: Long known as a fine source of hard-to-find components and surplus military gear (some of which work on 50 MHz), Fair Radio lists a collapsable log-periodic beam. Built for the military, it tunes from 30-70 MHz. The catalogue is available from Box 1105, Lima, Ohio 45802.

MALDOL USA: An interesting 2-element beam with both elements fed highlights this company's catalogue, which is available from 4711 NE 50th Street, Seattle, Wash. 98105.

(Continued on page 31, bottom)

George De Grazio, WFØK



We have received many inquiries into techniques for dressing out the front of project cases. Many hard lessons and trial and error have resulted in durable labels which do not abrade or disappear after many hours of use. The key to durability is protection through application of several layers of sprayed transparent overlay.

When I built my first project, I was very proud of it and did not wish to put it in a tuna can. I can appreciate using available free materials to cut costs or for a unique presentation, but I wanted my project case to have as nearly a commercial appearance as possible, given my limited tools and fabricating facility.

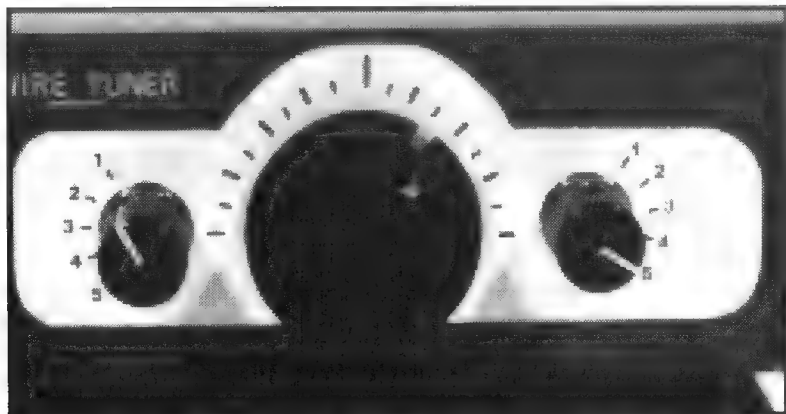
Materials Needed

were previously available at Radio Shack have been discontinued by them. These are produced for use in amateur radio and CB applications. A little sleuthing with the help of Bill Hickox, K5BDZ, led down the trail to Radio Parts (Co.?) in New Orleans, Louisiana¹. At press time, no prices on their sheets were yet received, but a phone call disclosed that these were, in fact, Datak-brand transfer sheets for amateur radio and CB use. We will confirm prices in the next issue.

"Transfer type" is basically a pressure sensitive, rub-off type decal that requires careful alignment before application. There are guides on the sheet to help with this. If the project case is freshly painted, give it at least 24 hours' drying time before applying the transfer type.

Transfer type: The Datak brand sheets that

Paint: I use spray enamel for project cases.



Above, below: Examples of shaped panels using a bandsaw. White (i.e., reversed) transfer type was applied to the painted project case.

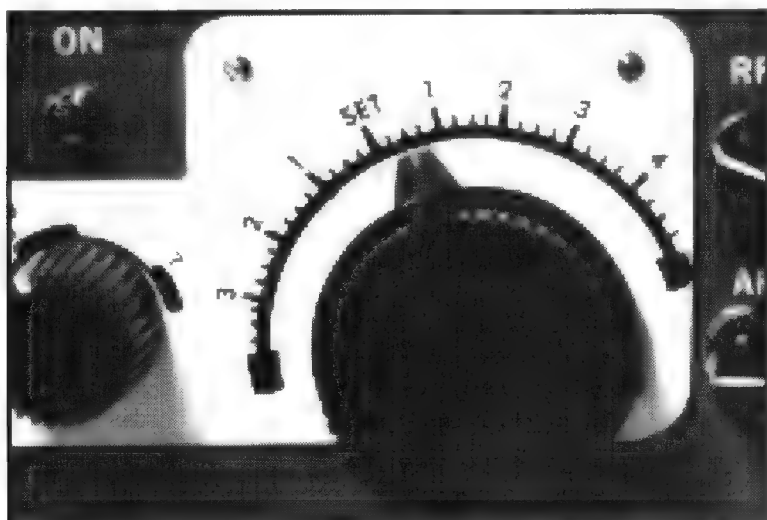
and prefer the type sold at Ace Hardware, though any good enamel is certainly alright to use, and another good source, though more expensive, is a hobby or model shop. They usually have some interesting shades of gray (my personal favorite color for radio cases) available.

PCB: I like to shape a single or double sided pc board for use as a label "panel". That way, it can be removed for frequency calibration, etc., or reworked if a mistake during transfer of

the type occurs. I use a matte-white appliance spray paint usually for painting frequency read-out or front indicator panels. It accepts the transfer-type most readily.

Drafting Pen and Ink: For circles and small lines on a frequency dial, I like to use a gravity-fed drafting pen and drafting compasses (see the photo at the beginning of the article).

Krylon-brand Fixative: After the type has been transferred, the front panel is lightly



fixed with a commercial transparent fixative spray such as Krylon. It is available in hardware, hobby and art stores.

Procedure

If a panel is being fabricated for application to a project case, and rounded (i.e., "radius") corners are desired, they can be rounded by use of a pair of tin snips, then smoothed with a small file. The whole pcb is then sanded on the presentation side for painting. I use a 220 grit emory paper, though a fine grit sandpaper works also. This is important to remove any grease or oil on the surface, and to make it most receptive to the paint.

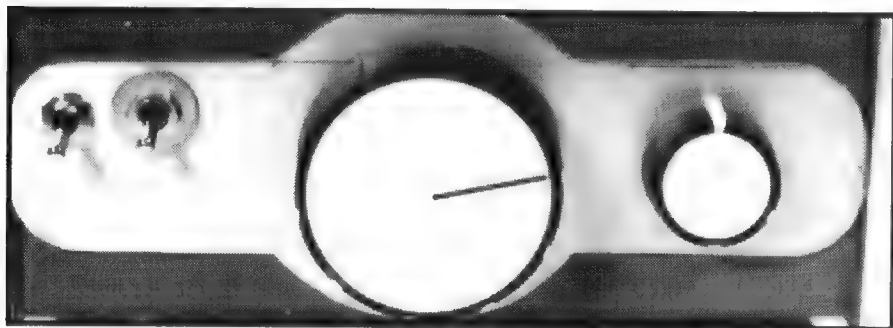
The painting part is an art (craft?), and must be practised carefully for best results. Try not

give the whole surface a *very light* coating of fixative. A heavy coat will dissolve part of the type surfaces and will destroy the appearance of the panel. Start with two very light dustings of fix, which, when dry, can then be coated more heavily. A commercial, sprayable version of Damar varnish can also be used for this, though it tends to yellow more with age.

I like to attach the panels to the case with four small bolts, in case I need to remove them later.

The main fun in fabricating your own panels and project case fronts is having a customized layout for your controls with a professional appearance. The more time taken in the craft of this facet of the process, the more fun in the operation of the project!

I have not dealt here with the some of the



Fitting and re-fitting: A panel, prior to lettering, is checked for final position.

to apply the paint in one coat. Several light coats work best, and baking in the oven between coats insures a good bond (bake until just hot enough to handle). At the very minimum, be sure to bake the paint at the end of the painting process. Failure to do so usually results in the removal of paint in chips when the transfer type is rubbed onto the surface of the project case or panel. If this happens in moderation, it can be retouched by spraying some of the paint onto a piece of paper, then using a small touch-up brush to "spot" the defect(s).

I apply transfer type with a special burnishing tool purchased at an art store. Any smooth surfaced tool will work fine. Some folks use a ballpoint pen (tip or base).

Once the type is on the panel or project case,

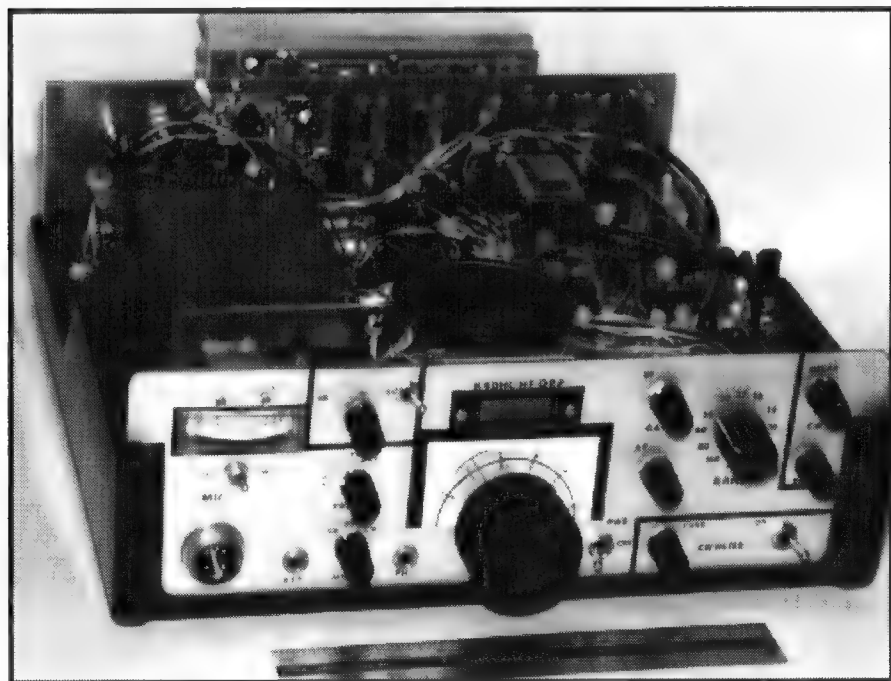
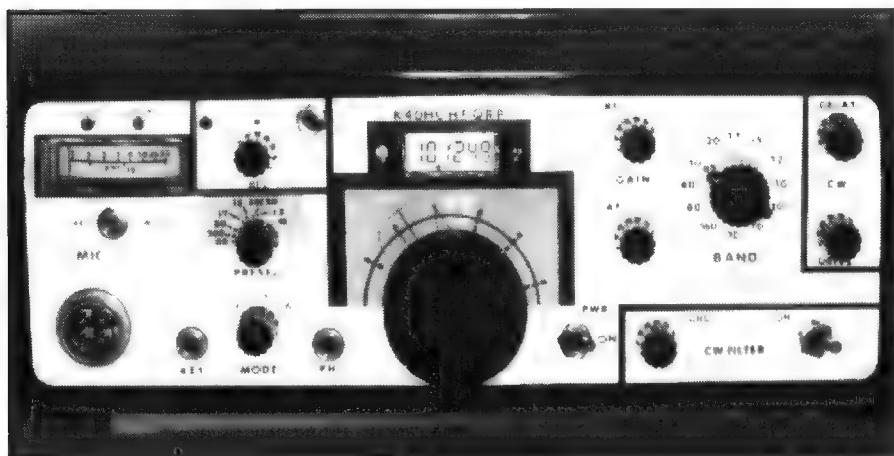
many other options (some much simpler), like using CAD layouts or Word Processors to set up the type, etc. These can be very useful also. Scrap plastic, such as found as containers in delicatessens and supermarkets are excellent free sources of protective covering for labels printed on paper or card stock.

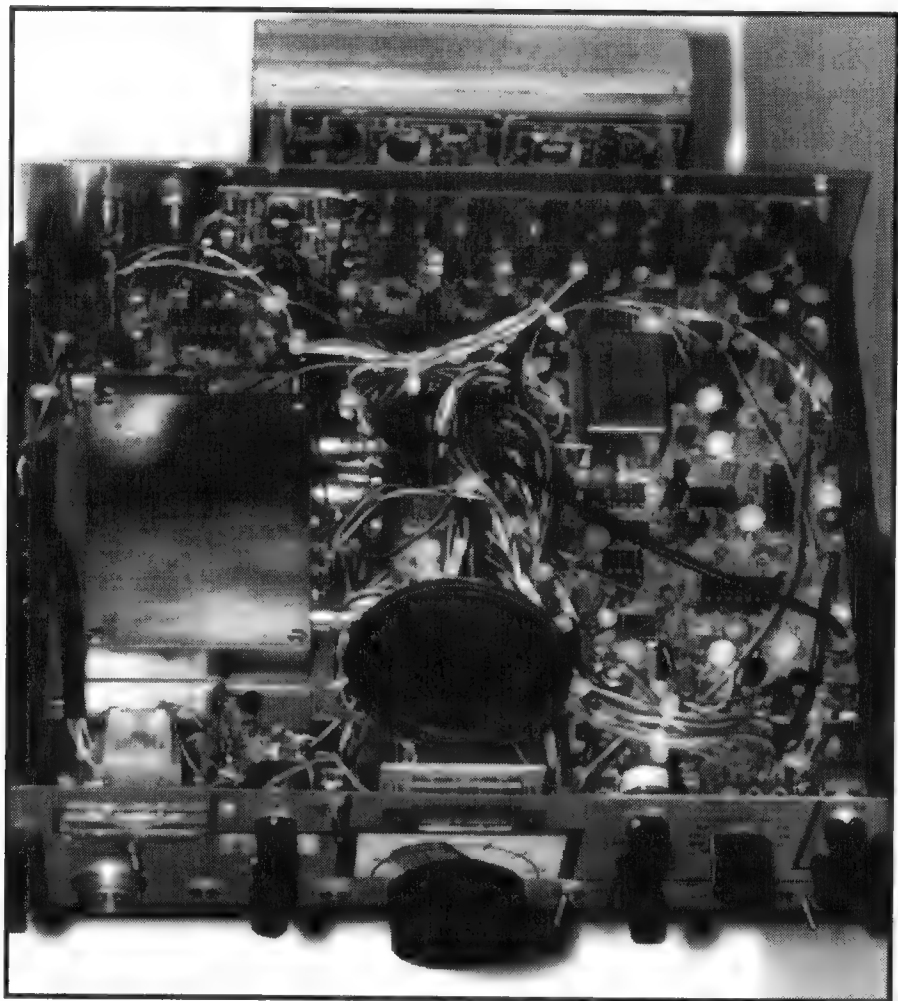
Footnotes:

1. Datak sheets are available from
*Radio Parts, 1331 Prytania Street,
New Orleans, Louisiana 70130
Information: (504) 581-5959*

No prices available yet.

◆ RIGSHOTS ◆





This gorgeous rig was built by Raymond Megirian, K4DHC, of Deerfield Beach, Florida. Ray tells us

"I've been inactive since 1954 but have never stopped experimenting and building projects I've dreamed up. I recently became interested in QRP operation and built the all-band HF transceiver shown in the enclosed photos. It runs 10 watts max output ssb and cw. Features include 6-digit frequency readout, synthesized LO, cw filter, etc.. I built this rig for a good friend of mine, N14Q, who lives in Orlando and he's had a ball with it. I have now completed a similar rig for myself and have had several QSOs with N14Q on 40 and 75, Hi!

(photos by K4DHC)

My List of Mail Order Electronics Companies

John Woods, WB7EEL

jfw@jfwhome.funhouse.com

Here is my list of companies which will sell electronic components in small quantities. Many of these places I have bought from, several I haven't. Being a ham radio operator, I am most interested in RF components, and in particular, air variable capacitors, which tend to be scarce (and tend to be used or surplus even if I've otherwise labelled the seller as "NEW").

Categories are: • **NEW COMPONENTS:** Distributors and sellers of new components, or "new and some used" in a couple of cases. • **SURPLUS ELECTRONICS:** Usually overstocks, occasionally used equipment. Ideal for stocking the junkbox, usually have dependable stock lines of resistors, capacitors, and some semiconductors, but won't have those LCD modules forever... An invaluable resource, don't shy away from them. • **SPECIALTY COMPONENTS:** In particular, crystals and toroidal cores. • **KITS:** Ham radio kits, random electronic kits, whatever they have. • **LITTLE GUYS:** Separated out because of some twisted sentimentality, I suppose. Intended to honor one or two ham spare-bedroom operations. Note that sending \$1 along with catalog requests is a big help for these folks. • **PUBLICATIONS:** A small selection of publications dealing with electronics, especially RF electronics. • **QRP CLUB PUBLICATIONS:** Clubs for low-power amateur radio enthusiasts; frequently have publications with quite a bit of technical content (which is why I'm a member of QRP clubs headquartered thousands of miles from where I live. Note, this is generally practical technical content (how to build it) rather than theoretical technical content (why it works), but definitely more than Contester's Quarterly.

Note on shipping costs: I don't always update these frequently enough, and they're generally for continental US unless otherwise mentioned.

SPECIALTY COMPONENTS:

JAN Crystals

2341 Crystal Drive, P.O. Box 06017, Fort Myers FL 33906-6017

800-JAN-XTAL (Monday through Thursday)

813-936-3750 (FAX)

813-936-2397 (plant)

They make crystals. Minimum order is \$10, which might be one crystal, or might be two.

Crystek Corporation

2351/2371 Crystal Drive, P.O. Box 06135

Fort Myers FL 33906-6135

800-237-3061 (M-F) (US and Canada but not Alaska and Hawaii)

813-936-2109

813-939-4226 (FAX)

They make crystals too. They were the cheapest last time I ordered, but I don't have an up-to-date price list. It took about 4 weeks, and they had said it would take 6.

CM (International Crystal Manufacturing Co., Inc.)

701 W. Sheridan, PO Box 26330

Oklahoma City OK 73126-0330

800-426-9825

More crystals. They were more expensive, but they have lots of pre-made crystals for various rigs, so they would probably be faster.

Amidon Associates

3122 Alpine Way
Santa Ana, Calif. 92074
714-850-4660

Toroid cores and related things. Very fast service. Now takes MC/Visa and phone orders. I think this is their current address, they seem to move a lot.

Palomar Engineers

Box 462222
Escondido CA 92046
619-747-3343
619-747-3346 (FAX)

Toroid cores and shielding beads, baluns, frequency meters, etc. Call for free catalog.

RF Parts

435 South Pacific Street
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(Continued from page 24)

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CUBEX ANTENNA Co.: This company has made a line of well-respected HF quads for years, and it has recently added a 2-element quad for 6 meters to its line. Catalogue is available from 2761 Stadium Street, Unit E, Brea, Calif. 92621. 714-577-9009.

M²: Another company that's been steadily building a name with its beams and mobile antennas, M² has yagis of from 5 to 11 elements with booms as long as 50 feet. Catalogue from 7560 North Del Mar Avenue, Fresno, Calif. 93711. 209 432-8873.

BUILD IT YOURSELF: It's always possible to roll your own beam quad for 6 meters. The elements are not difficult to make, and feed systems do not have to be elaborate.

Beginning with *QST* for August 1982, the ARRL has printed and reprinted an excellent piece on building beams, based on work by the National Bureau of Standards. It has appeared

in various editions of the ARRL Handbook and/or its Antenna Book.

Other pieces on 6-meter beams can be found in the Amateur Radio press over the years. Some typical offerings are in *ham radio* for July 1988, *CQ* for July 1980, and *QST* for June 1980. An interesting piece on the Omega Match for feeding beams appeared in *CQ* for January 1980.

One major problem facing would-be beam builders is where to find tubing and mounting hardware. Building-supply and some hardware stores stock aluminum tubing, usually in 12-foot lengths, which is ideal for 6-meter beams. Texas Towers also sells tubing: 1108 Summit Avenue, Plano, Texas 75074. 800-272-3467.

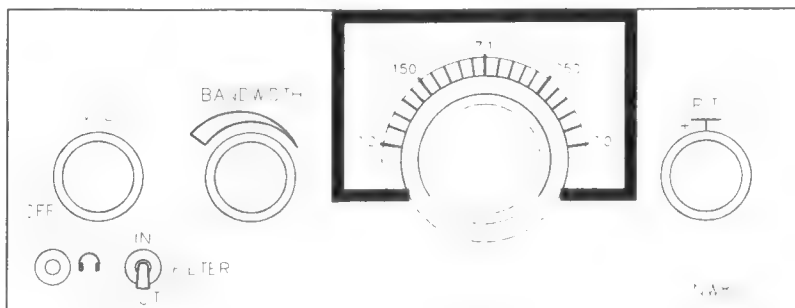
Rutland Arrays lists beam parts in its catalogue, and another source is Cubex, which sells sturdy boom-to-mast couplers, spiders and other components.

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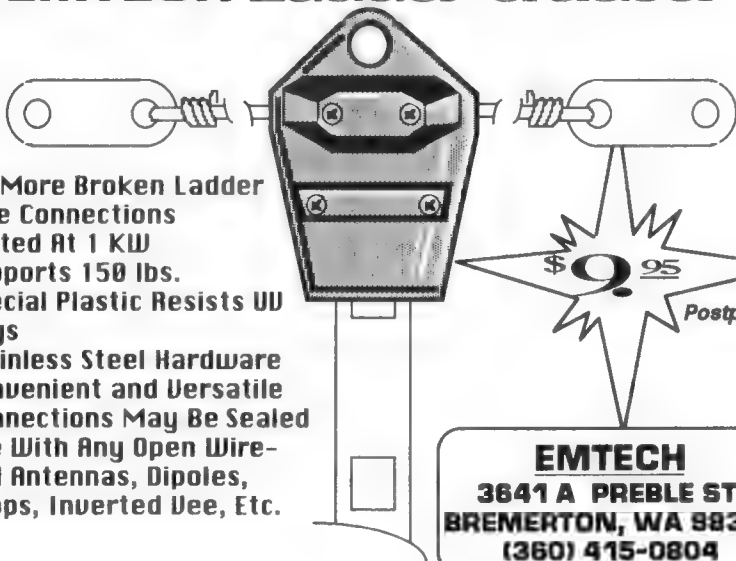


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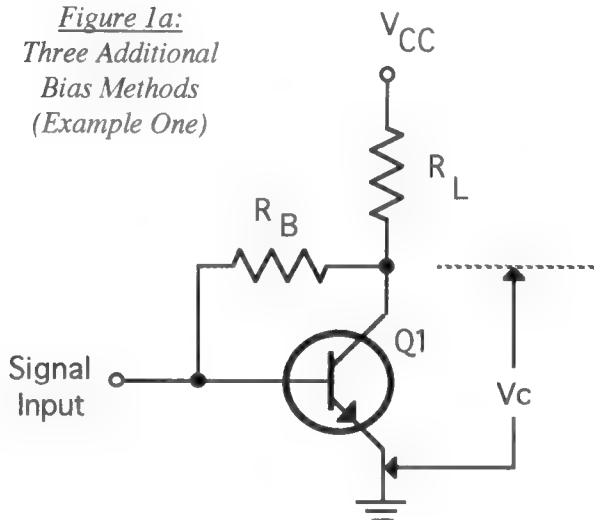
DESIGN BASICS SERIES

Thoughts On Theory

Transistor Biasing - Part IV

James G. Lee, W6VAT

*Figure 1a:
Three Additional
Bias Methods
(Example One)*



There are three other types of biasing sometimes seen in circuitry, and two of them use negative feedback to reduce the effect of changes in temperature and β . FIGURES 1a, 1b, and 1c show their application. FIGURE 1a shows base bias with the bias resistor R_B returned directly to the collector rather than the supply voltage V_{CC} . This provides negative feedback by reducing the voltage available to generate the base current. If β increases for some reason, the collector current increases thereby lowering the collector voltage V_C . This then reduces the base current and tends to offset the rise in β .

FIGURE 1b shows this same technique applied to base bias with emitter feedback. Recall in TRANSISTOR BIASING - Part II, I

showed how adding an emitter resistor to a base-biased stage provided negative feedback to stabilize the circuit against increases in β . Collector feedback takes that concept one step further. An increase in β causes a greater voltage drop across the emitter resistor R_E lowering the collector voltage V_C . This then provides even less voltage across R_B further reducing the base current and the effects of β . Again use Ohm's law to calculate the new value of R_B from the value of V_C rather than V_{CC} .

Finally, FIGURE 1c shows a two-supply method of biasing. Here a second supply, V_{EE} - of opposite polarity to the collector supply V_{CC} - is connected to the emitter through R_E . As in Part II, R_E is made about 5 times the

Figure 1b:
Three Additional
Bias Methods
(Example Two)

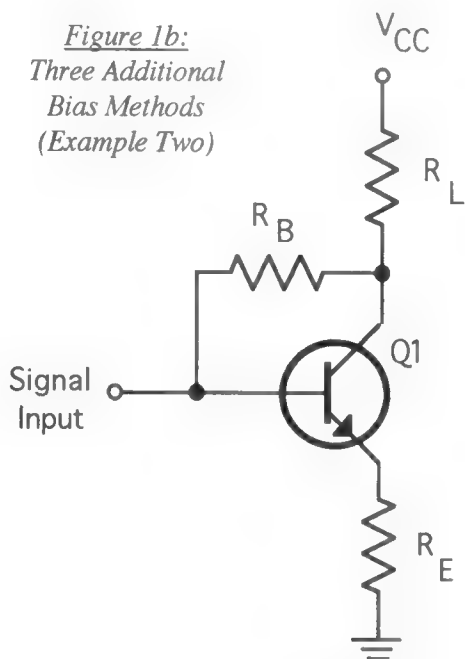
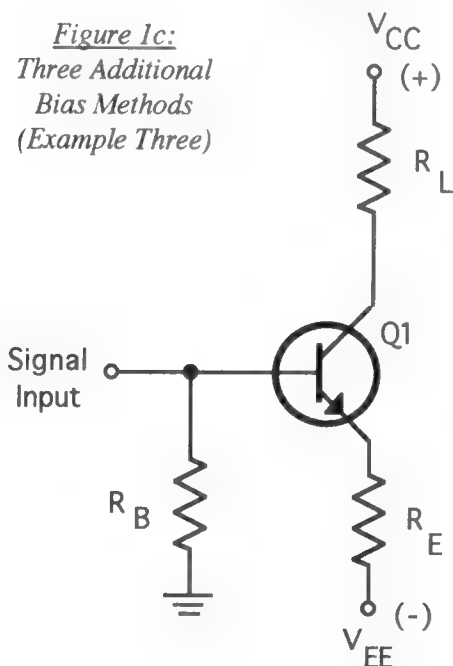


Figure 1c:
Three Additional
Bias Methods
(Example Three)



intrinsic base-emitter resistance r_{be} . So if R_B is made much, much less than β times R_E the collector current will be primarily a function of V_{EE}/R_E significantly reducing its dependence on β . This is good from an operating standpoint but requires a second supply which may or may not be desirable or available. Note that since the collector current and the emitter current are essentially the same, the second supply must have the same current capabilities as the normal collector supply.

IMPEDANCE MATCHING

Last time I showed how the output impedance seen by an amplifier changes when you add the input impedance of another stage to its collector load resistor, R_L (Remember you can think of impedance as AC resistance). When a signal is applied the operating conditions of the amplifier, then follow the AC load line rather than the DC load line. The maximum unclipped peak-to-peak voltage is reduced because of the lower impedance seen by the collector of the first stage. If this lower impedance does not allow you to develop as much gain as you need, there are some things you can do to change it.

The input impedance of a common-emitter stage is made up of the parallel combination of any biasing resistors, the intrinsic base-emitter resistance r_{be} , and any *unbypassed* emitter resistance. Recall that if the emitter resistance, R_E , is bypassed it is not visible to the signal. FIGURE 2 shows the AC schematic representation of two typical low frequency transistor stages. The bias resistors are in parallel with the input impedance of each transistor. In this case, the emitter resistance is not visible to the signal since it is bypassed. The intrinsic base-emitter resistance r_{be} in ohms is equal to $26 / I_E$ where I_E is in mA.

Normally the bias resistors R_B and R_S are much greater in value than r_{be} , and can be neglected. If the stage draws 1 mA of emitter current, then r_{be} is 26 ohms, which is very low. If it weren't for our old friend β , it would be practically impossible to put a signal through the transistor. Beta has the effect of multiplying r_{be} so the true input impedance is βr_{be} . For $\beta = 100$ the input impedance is now 2600 ohms. This is a much more manageable value, and if the load resistor R_L is 1000 ohms, then its parallel value with 2600 ohms is 722 ohms. This is close to the DC load value of 1000 ohms. Put another way the slope of our AC

Figure 2:
*AC Circuit Equivalent
of 2 Stages*

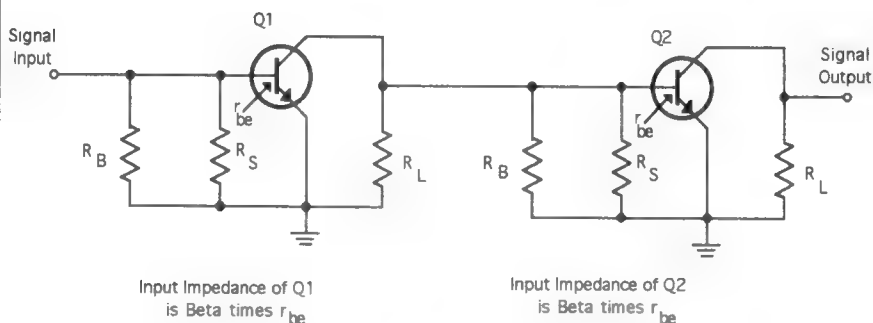
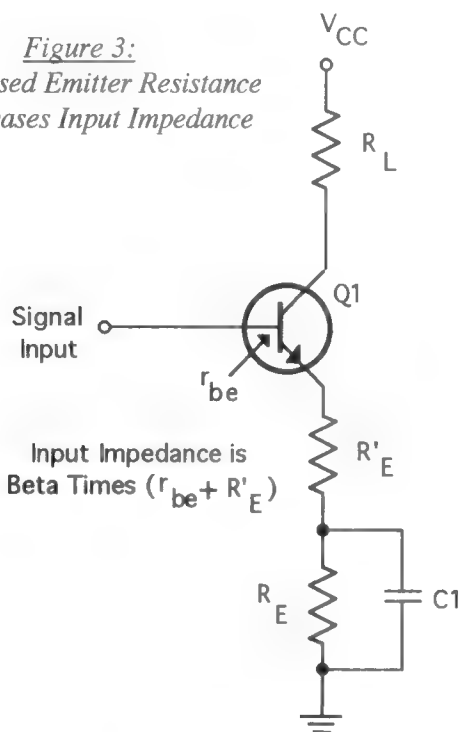


Figure 3:
Unbypassed Emitter Resistance
 R'_E Increases Input Impedance



load line is now beginning to approach the slope of the DC load line, and the peak-to-peak output voltage swing is increasing .

Of course if the transistor draws more current, r_{be} will be proportionately smaller, and the total AC impedance will drop low again. But there are at least two ways out of all of this. First you can again use our friend β in a way to keep the impedance high. Simply choose a transistor with a higher β , assuming the transistor will work in the circuit. For example, if you use a collector current of 2 mA. then r_{be} will be 13 ohms and the input impedance will be 1300 ohms for $\beta = 100$. By choosing a transistor whose $\beta = 200$ however, the impedance goes back to 2600 ohms.

A second way out of this problem is to make part of the emitter resistor visible to the signal. In FIGURE 3 by making part of the emitter resistor visible to the signal, it adds to r_{be} and

when the series combination is multiplied by β the input impedance increases dramatically. If you make the AC (or unby-passed) part of the emitter resistor R_E equal to 50 ohms. then at 1 mA collector current, the total input impedance is $50 + 26 = 76$ ohms. For $\beta = 100$, this makes the total input impedance = 7600 ohms. This makes the AC load seen by the driving stage = 884 ohms. Again in the right direction for more output, but all this has a price.

When all or part of the emitter resistor becomes visible to the signal, it reduces the signal handling capability of the stage. In essence it adds AC degeneration since it develops a voltage across the unbypassed resistance R'_E that is "in phase" with the applied signal. This lowers the input signal seen by the transistor. and consequently limits the gain of the stage. It also affects the low frequency response somewhat, although this is

usually not enough to worry about.

AMPLIFIER GAIN

The voltage gain of a common-emitter amplifier is easily found by dividing the output voltage v_{out} by the input voltage v_{in} . Often this ratio is designated by the letter A, or:

$$A = v_{out} / v_{in}$$

The input signal voltage is the product of the base current i_b times the input impedance βr_{be} . The output signal voltage is the collector current βi_b times load resistance r_L , where r_L is the total impedance seen by the driving stage.

So A becomes:

$$A = i_b \beta r_L / i_b \beta r_{be}, \text{ and so } A = r_L / r_{be}.$$

If there is any unbypassed emitter resistance, R'_E , it must be added to r_{be} , thus lowering the gain of the stage. The complete formula for gain is then:

$$A = r_L / (r_{be} + R'_E).$$

How much effect does R'_E have on the total

gain of the stage in our example above? The AC load resistance was 884 ohms and with $R'_E = 50$ ohms, then:

$$A = 884 / (26 + 50) = 11.6$$

The logarithm of 11.6 = 1.07, and since we are talking voltages this value is multiplied by 20 to equal a bit over 21 dB. But without the 50 ohms in the circuit you find:

$$A = 722 / 26 = 27.8$$

This appears to be a good place to stop and let you catch your breath. If you have problems with biasing transistors, and are a bit confused, it helps to review the material presented in the past few installments. You can easily see the design of a transistor amplifier begins with a number of variables which you have some control over. The collector current, the desired load impedance, the transistor's β , and the stage gain are just a few you can choose. You may have to accept compromises on such things as gain, and input/output impedances in order to get the circuitry you want. Again note that I have used only Ohm's law in all of the equations up to now. But the mathematics are simple and with a little patience, a good sharp pencil, and some scratch paper you can design the circuitry you want. - W6VAT

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(Continued from page 8)

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